STREAM CHANNELS

Characterization

The Coast Range is a north-south trending anticline, dissected by east-west stream systems. The main river valleys, such as the Coos River, are well entrenched and lie generally at elevations below 500 feet. The river gradients are gentle except near the headwaters. The valley bottoms are seldom more than a half mile wide. Tributary drainages, such as Tioga Creek, consist of narrow canyons of much steeper gradients.

The South Fork Coos Watershed is drained by 1,807 miles of streams. Because of steep slopes, thin soils and lack of water storage as snow in the higher elevations of the Watershed, runoff follows the precipitation pattern with winter excess and summer drought. The Watershed has little surface water storage to augment low late summer flows. High flows in channelized streams that were historically unconfined, during winter, contribute to accelerated channel scouring, sedimentation, and bank failure as these stream types try to reestablish a more stable dimension, pattern and profile.

The Watershed has a high drainage density, generally arranged in a dendritic pattern. Drainage densities average 7.2 mi./sq. mi (see Table CHAN-1). The Watershed is further subdivided into 4 subwatersheds and 25 drainages. These hydrologic units are listed on Table Intro-1 in the Introduction Chapter. The South Fork Coos River joins with the Millicoma River to form Coos River, which in turn, flows into the Coos Bay estuary.

Table CHAN-1: Stream Order Miles in the South Fork Coos Watershed

	Stream Order*							
	1	2	3	4	5	6	7	Total
Miles of stream	1,039	378	185	91	43	31	40	1,807
Drainage Density (Mi/mi^2)	4.1	1.5	0.7	0.4	0.2	0.1	0.2	7.2

* Relative position of streams, where all exterior links are order 1, and preceding downstream, the confluence of two like orders result in existing stream order +1. The junction of two different orders retains the higher order, and the main stream always has the highest order (Strahler 1957).

Stream types can best be described by stream channel similarities and differences. The Rosgen classification system was used as a basis for comparisons (Rosgen 1994). Letter designation in the Rosgen's classification system identifies the channel gradient and other general hydraulic relationships. The number designation refers to the substrate type. The text “Applied River Morphology” (Rosgen 1996) explains this classification system in detail. Table CHAN-2 below, shows generalized hydraulic relationships for Rosgen Stream Types found in the South Fork Coos River Watershed Analysis area. Many stream reaches will have different channel types at different locations along the reach, but due to the scale of this analysis, those local conditions would have to be addressed on a project basis.

Table CHAN-2: Rosgen Stream Types
(Channel material: 1 = bedrock; 2 = boulders; 3 = cobble; 4 = gravel; 5 = sand; 6 = silt/clay)

A Type Channels - headwater (A1a+, A2a+, A1, & A2)	B Type Channels - step/pool (B1 - B4)	C Type Channels - pool/riffle (C4, & C5)	F Type Channels - pool/glide (F1-F6)
Low order headwater reaches characterized by high gradient (>4%), cascade, step-pool channel development. The channels with slopes <10% are designated as Aa+ types	Mid-order, moderate relief reaches characterized by 2-4% gradients.	Higher order, alluvial, broader valley reaches characterized by low gradient (<2%), meandering, point-bar, riffle/pool channel development.	Higher order, alluvial, broader valley reaches characterized by low gradient (<2%). Meandering. Central and traverse bar development.
Entrenched, with low width/depth ratios, low sinuosity(1.0 to 1.2), and have little flood plain development. The Aa+ channels are deeply intrenched.	Rapid-dominated, pool limited systems that are moderately entrenched, have a moderate width/depth ratio, moderate sinuosity (>1.2), and limited flood plain development.	Not entrenched, have high width/depth ratios, high sinuosity (>1.4), and have extensive flood plain development.	Deeply entrenched, sometimes structurally controlled, high to very high width/depth ratios at the bankfull stage, moderate to high sinuosity.
High energy (high sheer stress), dissipate energy through turbulent flow provided by the step/pool mechanism. This channel type is prone to debris torrents triggered by debris avalanches; can transport and deliver large volumes of sediment and woody debris.	Dissipate stream energy by maintaining stream velocities in the form of turbulent flow and overcoming resistance to flow provided by roughness.	Lower energy systems that dissipate stream energy through the channel geometry and the meander pattern.	Lower energy systems that dissipate stream energy through the channel geometry and the meander pattern. Can develop very high bank erosion rates, significant bar deposition and accelerated channel aggradation and/or degradation with very high sediment supply and storage capacities.
Stable when controlled by bedrock, boulders or large cobble.	Stable throughout the range of substrates.	Stable in bedrock/boulder controlled channels. Channels with other substrate size classes are unstable.	Stable in bedrock/boulder controlled channels. Channels with other substrate size classes are unstable.

Tioga Creek Tier 1Watershed: The Tioga Creek Subwatershed is rugged, water cut, deeply dissected and heavily forested. The drainage pattern is dendritic and has a density of 8.0 miles/square mile. The Tioga Creek main stem is a 6th order stream. The Tioga Creek Subwatershed contains two 5th order tributaries and thirteen 4th order tributaries.

Tioga Creek contains A, B, and C Rosgen channel types. The main stem of Tioga Creek evolves from a B type to a C type channel as it progresses downstream. The upper 5 miles is a B type channel while the remaining 13 miles is a C type channel. All of the major tributaries to Tioga Creek are B type channels with the exceptions of: the lower 1/4 mile of Buck Creek and the lower 1/4 mile of the West Fork of Tioga Creek, which are both C type channels. The remaining lower order channels are A type channels with a few exceptions. The gradient and density of stream channels are, to some extent, controlled by the hardness, density, and massiveness of different members of the Tyee Geological Formation.

Current Conditions

Most of the Watershed is steep, water-cut, deeply dissected, and forested. All of the drainages start as

A type channels, evolve into B type, and finally into C and F type channels. The lower main stem of the South Fork Coos below Dellwood is low gradient. Because of the combination of geologic uplift and river downcutting, the upper end of this reach is an intrenched channel bordered by terraces. The lowest reach of the South Fork Coos and the Coos River main stem flow through a flood plain. These flood plain reaches are contained by levees.

Very High Gradient Channels, Rosgen Aa+ Stream Types: The Aa+ stream types are very high gradient (?10%), V-shaped, erosional, straight channels. Aa+ stream types are found at the upper ends of drainages in dissected topography. These channels are usually 1st order streams.

A1a+ stream types are steep (>10%) stream types on bedrock and prone to the debris avalanche and shallow rapid debris flow process. The avalanches, debris slides and sometimes resulting torrents usually occur when concave hollows on headwalls above these channels are loaded with colluvium, soil materials and organic debris by natural or disturbance processes. Debris avalanches and shallow rapid debris torrents are primary in shaping and influencing these headwater V erosional stream channels. Debris torrents are masses of water, mud, rock and large woody debris (LWD) that may move in excess 40 mph down the channel and scour the channel to bedrock. Depending on channel constrictions and amount of debris, torrents can also scour high bank areas. During debris torrents, materials sorting occurs where large rocks and LWD rise to the top. LWD in or suspended over the stream channel can slow and sometimes stop a debris torrent. Debris torrents are natural events in these stream types. These events are linked to prolonged storms when daily precipitation exceeds 4 inches and soils are already saturated. However, inappropriate road building practices and logging without due consideration for unstable sites increased the rate and runout distance of these events in the 1950's through the 1970's. Debris torrents typically stop at channel constrictions or just above a high angle (>70 degrees) tributary junctions (Benda 1985). These torrent deposits are then reworked by the stream over a period of years and supply gravel and other particle sizes to downstream reaches. Debris torrents can temporarily dam higher order channels, which results in dam break floods.

High Gradient Channels, Rosgen A Stream Types: These A stream types are high gradient (4-9.9%), V-shaped, erosional, straight channels which lack a flood plain. They are found at the upper end of drainages. Many are confined by bedrock channels and steep banks. They are usually 1st and 2nd order streams. The main process influencing these channels are infrequent landsliding and debris torrents. These channels are moderately sensitive to disturbance, have good recovery potentials and moderate stream bank erosion potentials. Sediment supply is low-moderate, except when fire or torrents occur.

Another variation of type A channels occurs in 1st and 2nd streams on silt/clay substrates. These A5-A6 channel types originate from seeps and have a very low continuous summer flow. Some of these channels are draining perched layers of water in deep soils on gently sloping land forms. They are very sensitive to disturbance, have poor recovery potentials and very high streambank erosion potentials. Sediment supply is very high.

Moderate Gradient Channels, Rosgen B Stream Types: The B stream types are moderate gradient (2-3.9%), slightly meandering, step/pool streams with limited or no flood plain. Boulders and cobbles dominate the substrates and these streams receive frequent inputs of sediment. The B stream types have little transport capability beyond catastrophic landslide or flooding events. These third through fifth order streams receive water, gravels and sediment, nutrients and some LWD inputs from the headwater stream types. The B type channels have larger drainage areas, greater flows than the A types, and most are 3rd or 4th order perennial streams. Few B type channel streams in the analysis area are unaffected by past management and most of those are in the LSR part of the Watershed.

The time from the onset of precipitation to the point of peak run-off is rapid for tributary step/pool streams. This is because the distances and travel times from the first through third order headwater streams are uniform due to the dendritic stream pattern. The rapid rise and fall pattern does not allow for lengthy transport of LWD. In contrast, the peak flow for the mainstem step/pool stream types is delayed and the duration may be extended depending on how synchronized the run-off is from the tributary streams. Management activities can influence the extent of run-off synchronization in the tributary streams. These streams are the transitional streams between the headwater streams and the pool/riffle dominated streams.

Historically, this channel type contained steps formed by large woody debris (LWD) that dissipated stream energy and prevented lateral adjustment or bank cutting. Embedded LWD spanning the channel created low velocity flats onto which sediments were deposited for long term storage. The main processes affecting these channels are the input of water, sediment and LWD from upslope channel segments, and some naturally occurring bank cutting and entrenchment in response to changes in LWD levels and positions in the channels. Salvage logging and stream cleaning in this channel type reduced the naturally occurring levels of LWD in the affected channels resulting in channel widening and down cutting or entrenchment. Normally, sediment accessed from streambanks, or moved in from upstream stream types (A types), are temporarily stored behind obstructions or localized flats where natural stream grade controls are present. Where stream slopes exceeds about 2%, fine and coarse sediments are moved downstream during frequent flows. Streambank erosion rates are normally low as are the channel aggradation/degradation process rates. However, without LWD wood structure in the stream, limited areas are available to trap gravels for fish spawning beds.

Under premanagement conditions these stream types are moderately entrenched, riffle dominated types, with stepping features of infrequently spaced large pools at bends or areas of constrictions, and interspersed with cascades.

Low Gradient Channels, Rosgen C and F Stream Types: C stream types are low gradient (< 2%), meandering, wide, slightly entrenched to entrenched, pool/riffle streams with adjacent flood plains with a variety of substrates but with a high proportion of fines. They have large watershed source areas and are usually 4th order or greater streams located lower in the drainages. Most C channels are perennial streams, which flow through narrow flood plains, that develop upstream of channel restrictions (e.g., narrow valley widths, partial debris dams, etc.) or in alluvial valleys. These channels dissipate energy by meandering and flowing over rough material along the bank and streambed. The probable historic condition for these channel types included narrow streams which overflowed the stream bank and used the flood plains during floods. Their stream banks were stabilized by root masses including myrtle, maple, cedar and other tree species. Greater amounts of LWD were in these channel types, but living trees provided bank stability and were more important than the influence of log steps. These channels dissipate energy by meandering and flowing over roughness elements along the banks and streambed.

F stream types are similar to C types, but are vertically lowered and have no flood plain. Historically, this stream type was probably absent in the analysis area except for the terrace bordered reach below Dellwood.

Management associated modification of C channel types have caused riparian changes, and loss of stream pool volume and axial stream water storage in flood plains. The lower mainstem channel was modified in the 19th and 20th centuries by snagging to improve navigation, and levee construction to reduce flooding and to claim wetlands for agriculture (Mahaffy 1965). Daniels Creek was in places straightened to facilitate agriculture on the flood plain. Riparian trees were cut to clear farmland, and were also removed during timber harvest operations. Activities to facilitate log drives included removing instream wood, blasting boulders out of the channel, cutting riparian trees and cutting spanner logs. Splash damming and log drives have affected the South Fork Coos main stem channel downstream from Tioga Creek (Farnell 1979; Beckham 1990).

Ponds: There are no lakes in the Watershed. However, there are various small, natural and man-made ponds. These perennial and ephemeral ponds are habitat for a variety of aquatic life such as amphibians and macro-invertebrates that are not adapted to flowing water, or species that seek refuge from high winter water velocities in streams. Several man-made ponds are concrete lined and store water for fire suppression purposes. Other standing water habitats are sag ponds, roadside ditches, and seasonal wetlands. Little true wetland habitat remains in the Watershed. Most available wetland is associated with sag ponds, seeps, and on flood plains. Diking in the agricultural part of the Watershed has reduced the area in functioning flood plain wetlands.

Effects of past management: The following are some of the channel and flood plain changes observed in the Watershed:

Large areas of flood plain have been cleared and drained for development. The loss of vegetation maintained stream bank stability resulted in increased stream bank erosion. The loss of wood recruitment to the channel, along with loss of stream bank vegetation, reduced channel roughness. This in turn resulted in higher stream velocities that contribute to increased stream bank erosion and down cutting, and the loss and/or simplification of habitat, especially aquatic habitat that is critical during high flows. Down cutting resulted in some C type channels changing into F channel type.

Removal of stream side and flood plain vegetation has decreased the flood plain roughness. Flood plain roughness slows the movement of flood waters and the slower the water moves the more sediment settles out on to the flood plain. With less flood plain roughness, more sediment remains suspended in the flood waters to be deposited farther down stream and in the estuary.

Much of the channel roughness provided by LWD has been removed, which changed the flow from a turbulent or varied-velocity profile, to a laminar or consistent-velocity profile. As a result, the amount of backwater or low velocity, depositional areas provided by turbulent flow have been reduced. A decrease in the number velocity breaks has caused the channels to down-cut.

Many larger channels have scoured to bedrock or migrated laterally and have difficulty retaining substrate. The systems that can retain a substrate may have difficulty recruiting it due to the present road system. The stream-side and mid-slope roads function as terraces that trap material that would normally continue downhill to the channel.

Improperly sized culverts limit substrate recruitment by not transporting bedload down through the channel network. Undersized or blocked culverts can impound water and cause road failures that lead to large inputs of sediment.

In the managed landscape, large wood was lost from A and B channels where instream wood was removed by logging, overly aggressive stream cleaning, and as a result of debris torrents precipitated by road failures. Removal of large conifers that could reach the streams has diminished the contribution of large woody material into the streams. The loss of wood has not caused the A and B type streams to change into a different channel type, but has reduced instream habitat diversity, and changed the way the A and B type channels influence down stream reaches. The A type channels store sediment and wood and are sources of these materials for permanently flowing streams (FEMAT 1993, p V-36). Large wood captures and stores sediment and is critical in maintaining step-pool morphology in the A and B type small headwater streams. This step-pool morphology has the potential to delay flow from these tributaries during storm events and reduce peak flows downstream. A recent study by Curran (1999) found that spill resistance from step-pool reaches contributed 90% of the friction that slows water velocity in some Western Washington headwater streams.

The Erosion Processes chapter includes a history of stream cleaning, and of management activities that affected sediment and large wood delivery to the streams.

Reference Condition

Few low gradient reference condition stream reaches exist within the Watershed and none are larger than 5th order. All intact low gradient reaches have been affected to some degree by nearby upland or upstream activities. The Tioga Appendix: Upper Tioga Creek Stream & CWD Diagram contains maps of a reference condition segment of Tioga Creek with C stream type reaches.

A historic reconstruction of the flood plains and terraces down stream from Dellwood indicates that those flood plains once supported an array of vegetation types (see the 1857/1871 Vegetation Communities on the Lower Coos River Flood Plains and Terraces section in the Vegetation Appendix). The variation in vegetation types depended on the frequency and duration of seasonal flooding as affected by microtopography, distance from the estuary, and geologic scale uplift and down cutting. Map Veg-1 lists the vegetation communities and shows their locations on the Lower South Fork Coos and on the Coos River main stem.

The A and B type streams are confined by narrow valley morphology and bedrock, and therefore resist changes in slope, entrenchment, and sinuosity. Based on these characteristics, the A and B type channels in the managed landscape have changed little from their premanagement condition. Under premanagement conditions, the A and B type channels were dynamic systems where disturbance processes both delivered wood to these channels, and removed wood from these channels to be deposited in down stream in lower gradient reaches. In the managed landscape, large wood was lost from A and B channels where instream wood was removed by logging, overly aggressive stream cleaning, and as a result of debris torrents precipitated by road failures. Removal of large conifers that could reach the streams has diminished the contribution of large woody material into the streams. The loss of wood has not caused the A and B type streams to change into a different channel type, but has reduced instream habitat diversity, and changed the way the A and B type channels influence down stream reaches. The A type channels store sediment and wood and are sources of these materials for permanently flowing streams (FEMAT 1993, p V-36). Large wood captures and stores sediment and is critical in maintaining step-pool morphology in the A and B type small headwater streams. Research showed as much as 15 times the annual sediment yield stored behind wood in Idaho streams and between 100 to 150 years of average annual bedload stored behind wood debris in steep tributary streams in northern California (Megahan 1982; Keller *et al.* 1995, both cited in Curran 1999). The step-pool morphology has the potential to delay flow from these tributaries during storm events and reduce peak flows downstream. A recent study by Curran (1999) found the spill resistance in step-pool reaches contributed 90% of the friction that slows water velocity in some western Washington headwater streams.

Beaver dams and high densities of LWD in log jams in the unmanaged landscape had a role in maintaining pools and storing water in the channel and as ground water in the streambanks. This water was slowly released during the summer augmenting low flow water levels.

Synthesis & Interpretation
The different channel types have different dimensions, patterns, and profiles, and will respond differently to disturbance as well as restoration efforts. Table CHAN-3, below, lists some structures that may be appropriate for instream work by channel type, however, proposed projects have to be evaluated on-site to determine suitability.

Table CHAN-3: Appropriate In-stream Structures by Channel Type (Rosgen 1996)

Type A Channel	Type B Channel	Type C Channel	Type F Channel
Channel edge boulders	Very few limitations	Channel edge boulders	Channel edge boulders
Vortex rock weirs		Channel edge root wads	Channel edge rootwads
Channel edge root wads		"W" Weir or vortex rock weir	"W" Weirs or vortex rock weirs
		Bank cover	Bank cover

notes:
Channel edge boulders are not the same as riprap. Channel edge boulders are placed in the stream to provide instream cover and scour pools. Strategically placed boulders can divert high stream flows away from unstable banks. In contrast, riprap is a blanket of rocks intended armor stream banks and by that prevent channel movement.

Descriptions, illustrations and discussions on appropriate instream structures for each channel type are covered in the Applications section of the book Applied River Morphology by Rosgen (1996).

Management Affects on Stream Channels: Log transport early in the management history of the Watershed, construction of roads that restrict both channel migration and stream access to flood plains, loss of streamside vegetation, and loss large wood from instream and streamside locations directly affected sediment and large wood debris storage and recruitment, and altered stream channel functions and stability. Logging and stream cleaning associated LWD loss from the stream channels have caused degradation in all stream types, especially the moderate gradient B stream types. Channel complexity provided channel roughness that dissipated stream energy through turbulent flow and channel roughness. Removing the LWD from streams reduced channel roughness causing stream flow to change from turbulent (varied velocity profile) to laminar (consistent velocity profile). As a result, the amount of backwater or low velocity, deposition areas provided by turbulent flow have been reduced considerably. The decreased number of velocity breaks caused the channels to down cut and widen to dissipate stream energy no longer used in the step/pool flow pattern.

Before stream buffers became a common practice, the stream side trees that anchored stream banks were cut during logging operations. This common practice destabilized stream banks causing channel instability along the low gradient C stream types. This combined with the removal of large wood from these channels for navigational, economic and fish passage purposes resulted in the flood plain streams down cutting and widening. This lowered the water table in the flood plain and by that reduced the ability of ground water to augment stream low flows. The down cutting also converted many C stream types to the entrenched F type.

Sediment Transport and Deposition Processes: The A and B stream types, because of their steep gradients, rapidly transport coarse and fine sediment through them. These streams transport most sediment during only a few storms each winter. The limited sediment transport capacity outside of storm events is the result of low flow volumes attributable to the small catchment areas above the A and B type channels. Debris avalanches and debris torrents are the most important transport mechanisms of coarse and fine sediments in the Watershed. Areas that show the most evidence of debris avalanches and torrents from natural conditions and road and channel intersection failures are found in the upper watershed in the Flournoy, Tyee and Bateman formations. Mid-slope roads acting as interceptors, channel landform constrictions, LWD, and debris torrent deposits can slow the routing process (additional discussion in the Erosion Processes Chapter). Once depressions are filled by sediments behind obstructions, a new equilibrium is reached and incoming sediments will be held in suspension during the frequent flows and moved downstream. Sediment stored behind LWD or in debris fans will remain in storage for long periods. It can be mobilized again when the organic debris decay or a flood flow rearranges channel debris.

The C channels are low gradient, and the active channel dimensions are maintained by the frequent flows. These channels are unconfined at flood stage and entrained sediment will deposit on adjacent lateral flood plains. This is because the flood plains have wide areas spreading water at shallow depths and vegetation providing roughness, which lowers velocity to where coarse and fine sediments cannot be held in the water column. The C channels tend to be stable. If chronic or frequent pulses of sediment from upstream activities overwhelm the transport capability of the stream, aggradation will occur at moderate flows. With a high sediment supply, high flows will build a new higher flood plain, but the C channel will retain its approximate channel dimensions, but at a higher base level in the valley. Although the sediment supply is high, the surface streambed armor layer does not appear to be overwhelmed with fine sediments. Most coarse and fine sediments are near the bankfull stage at the margins of the active channel. This implies sediment transport is flow limited rather than supply limited.

<u>The Affects of Channel Morphology and Riparian Vegetation on Low Flows</u>: Water availability during late summer from base flow inherently is poor. This is due to the comparatively thin coarse-textured soils, which covers most of the Watershed, providing little ground water storage. There is an implied assumption that the low flow hydrology of the drainages has changed in response to natural events and management activities. This assumption is based on studies in similar drainages. A good discussion on the changes of low flow can be found in Part II, Chapters 3 of "Monitoring Guidelines to Evaluate Effects of Forestry Activities on Streams in the Pacific Northwest and Alaska" (MacDonald et al. 1991). Changes in channel morphology and riparian vegetation have affected low flows. Removal of forest vegetation has been shown to increase low flows by reducing evapotranspiration (Harr et al. 1979). However, because summer streamflows are very low in the South Fork Coos Watershed, the additional volume of water yielded from harvested areas is small. Conversion of tree species from conifer to red alder, can decrease summer low flows from preharvest conditions, because alders transpire more water than conifers during the summer (Hicks et al. 1991).

Morphological changes affecting the retention of low flows in the high gradient (>10%) low order (1-2) high energy channels have been slight. These correspond to the A type channels. Because most of these channels are intermittent; they do not retain summer water. Exceptions are channel types A5-A6 draining deep soils or small perched water tables. Some type A channels have been scoured to bedrock by debris flows. In regeneration harvest units, LWD has been removed from these channels, which acted as energy dissipation steps and sediment catchments. However, this change is not thought to affect retention of summer water.

Morphological changes affecting the retention of low flows in the moderate gradient (2-10%) middle order (2-3) transitional channels have been moderate. These are step/pool A and B type streams.

Removal of LWD has simplified these streams by eliminating the steps created by the wood and the flats that had formed behind them. These flats stored large volumes of sediment and near surface groundwater. Pool frequency and depth was higher, below each step. These conditions would allow more summer storage of water, when streamflows were naturally low.

Morphological changes affecting the retention of low flows in the higher order (4-5), low gradient (<2%), depositional stream channels, have been the greatest. The affected stream reaches are entrenched, and in some cases the streams no longer have access to their flood plains. Flood plains can provide considerable near surface groundwater storage. However, the depth of the water storage profile is diminished by channel incising. These stream reaches have also undergone much widening, increasing stream width and reducing depth. The removal of streambank riparian vegetation, instream LWD, and decline in beaver populations are largely responsible. Wide, shallow streams retain little water in pools. Sediment delivery from upstream sources may have further decreased pool volume by filling. More beaver dams were probably in the C stream types in the past, and their dams would have retained summer water volume.

<u>Stream Channel Trends</u>: The A1 stream types are static, and neither improving nor degrading. A5-A6 stream types are degrading at a slow rate due to headcutting. B stream types are continuing to degrade, where they lack sufficient LWD to form log steps, and when the base level is above bedrock. Some C stream types within the Watershed have converted to an F type, and cannot reasonably return to a former state. This channel entrenchment has drained much of the flood plain's stored water. Many F stream types would require sharp rises in the base level to reconnect with their flood plains, and that may not be possible under the present climate. It is more likely that eventually the F channel types will widen by bank cutting processes, and the river will construct a flood plain within the overfit channel. Bank cutting is being slowed in some reaches by bank materials and properties. Eventually, a C channel type may be restored within some wide F segments, but may take many years.

On those streams where a level of channel restoration was obtainable, instream structures like log and boulder weirs, have reversed the degradation by retaining sediments suitable for spawning and invertebrate habitat and increasing summer time in channel water storage. However, these reaches still lack the high level of structural complexity normally associated with intact systems that are operating at their full potential. In-stream structures have been installed on most of the accessible sites on BLM land where such structures would be beneficial. The remaining suitable sites are generally less accessible and in some cases require a higher level of design to be successful. At this stage the greater opportunity to do instream restoration is on private land.

<u>Stream side vegetation and channel type</u>: Although stream riparian areas may occupy only a small percentage of a watershed, they represent an extremely important component of the overall landscape and cannot be overlooked when addressing fish habitats. Under natural conditions in the Watershed, conifers (western redcedar, hemlock and Douglas-fir) dominate overstories in small V-shaped drainages. As stream size increase, hardwoods (red alder, bigleaf maple, myrtle and Oregon ash) become a more important component of the riparian forest. Hardwoods can dominate the lower elevation narrow flood plains (Reference Condition section in Water Quality Chapter) and areas subject to seasonally saturated soils. Conifers maintained a presence on the larger flood plains prior to land clearing for agriculture and the early timber harvests (1857/1871 Vegetation Communities on the Lower Coos River Flood Plains and Terraces section in the Vegetation Appendix). Rot *et al.* (2000) observed the species composition on flood plains was distinctly different from other streamside landforms. The flood plain plant community composition was controlled by relatively high flood frequencies and numerically dominated by hardwoods,

however, conifers represented a higher basal area. Conifers on flood plains were restricted to microtopographic ridges, tops of logs, and protected areas such as behind CWD accumulations. CWD accumulations sometimes may also protect conifer seedlings form browse damage. Rot and coauthors (2000) suggest that CWD on the flood plain provides an indirect service to the stream channel by providing protected microsites needed for conifers to survive and grow in close proximity to the stream.

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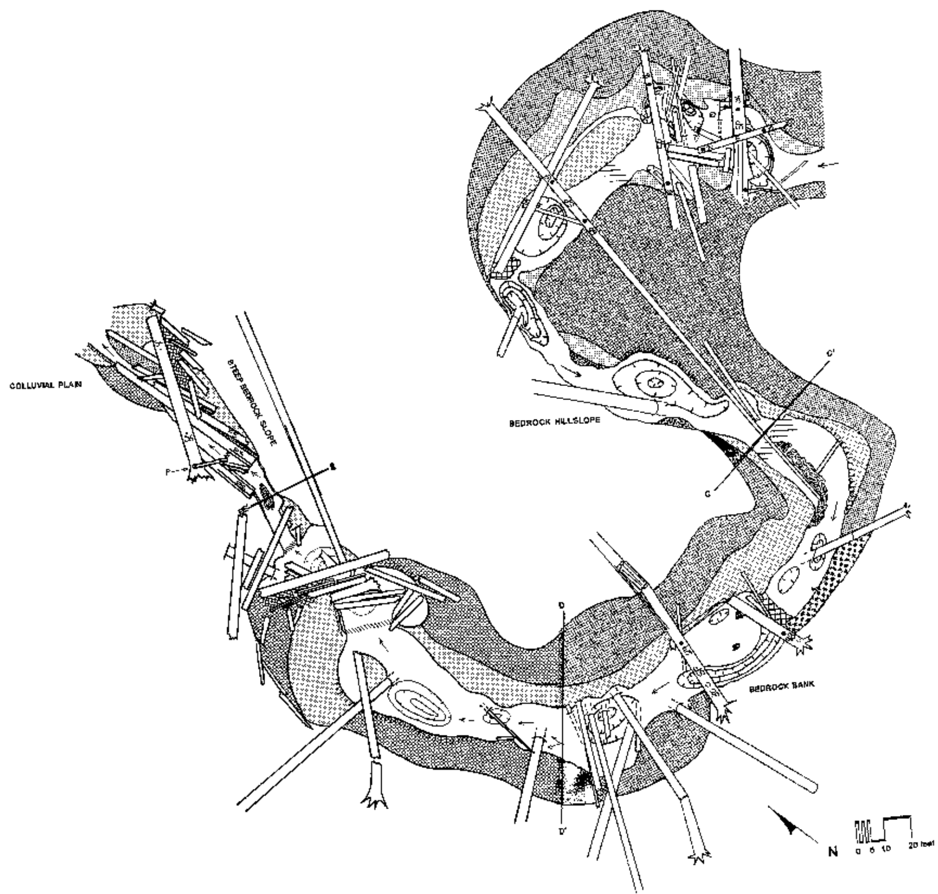

Diagram of a segment of Tioga Creek in 1995 showing the wood accumulations on the flood plain and in the channel. The complete set of diagrams is in "Tioga Appendix: Upper Tioga Creek Stream & CWD Diagram section.